

WINDOWS 2000 NETWORKING OVERVIEW

After reading this chapter and completing the exercises you will be able to:

- ◆ Describe many of the new features in Windows 2000
- ◆ Detail differences between the four main Windows 2000 product family members
- ◆ Explain the Windows 2000 networking architecture
- ◆ Define the major networking protocols supported by Windows 2000
- ◆ Recognize many of the networking services available in Windows 2000

New features and services in Windows 2000 raise the bar for the modern **network operating system (NOS)**. This chapter introduces you to several of these new features. It also describes the four products found in the Windows 2000 product family. In addition, this entire book focuses on networking, protocols, and networking services. This chapter introduces you to each of these topics, in particular, the Windows 2000 network architecture, networking protocols, and networking services.

NEW FEATURES IN WINDOWS 2000

Windows 2000 includes most features found in Windows NT 4.0 and expands those features to include many new and useful items. The people at Microsoft listened to what customers needed in order to expand their networks and used many of their suggestions in Windows 2000. The list that follows enumerates many of the new features in the operating system. The list is not comprehensive. Instead, it focuses on the most important new features and two features that were once part of either the Enterprise version of NT or available only via add-on software: clustering and terminal services, respectively. The most notable new features are:

- **Active Directory (AD) services:** Active Directory is an enterprise-level directory service used to simplify administration and management of Windows 2000 networks. AD extends the Windows NT 4.0 domain model by building a framework for combining many domains into a single AD tree or forest. Within this overall directory, objects represent all networking resources, such as users, computers, and printers. **Objects** are components within the AD structure that can have **attributes** defined for them. For example, user accounts are objects about which attributes such as First and Last name can be defined. AD operates in two different modes: **native mode** and **mixed mode**. Native mode is used on networks where only Windows 2000 domain controllers reside, on a network either fully migrated to Windows 2000 or on a network with Windows 2000 newly installed. Mixed mode allows Windows NT 4.0 domain controllers and Windows 2000 domain controllers to function and reside in the same domain. This design allows for coexistence until all Windows NT 4.0 domain controllers can be migrated to Windows 2000. This book discusses Active Directory as it relates to networking services. For more information on Active Directory, refer to *MCSE Guide to Microsoft Windows 2000 Active Directory* (ISBN 0-619-01600-0, copyright 2001).
- **Enhanced security:** Windows 2000 uses **Kerberos version 5** security to provide client-to-server or user-to-Active Directory authentication. Kerberos replaces the weak security found in the Windows NT 4.0 NT LAN Manager security with a shared secret key authentication system. Unfortunately, in a mixed mode configuration, Windows 2000 can and does allow authentication using Windows NT LAN manager methods. Therefore, you should upgrade all domain controllers to native mode to take full advantage of Kerberos security.
- **Encrypting file system (EFS):** Windows 2000 extends existing Windows NT 4.0 attributes allowed for files and folders with the encrypting file system or EFS. EFS, like the compression attribute, requires that a drive be formatted with NTFS. EFS allows file and folder encryption on a per user basis.
- **IP security (IPSec) protocol:** This set of predominately network layer protocols provides data integrity, end-to-end confidentiality, and network authentication. IPSec allows encryption of data packets within a local area network (LAN) or across a wide area network (WAN). Windows 2000 implements IPSec below the Transport layer of the **Open System Interconnection (OSI)** model. This makes IPSec policies transparent to normal network users.

- **Plug and play support:** Windows 2000 fully supports plug and play devices. Network administrators finally have the ease of installation and use of devices associated with the Windows 9x product family. This feature automatically detects most installed or connected hardware devices. Plug and play support also allows for the hot insertion of devices such as PC cards. (Microsoft recommends stopping PC cards before ejecting.) Figure 1-1 shows the Unplug or Eject Hardware dialog box where you can stop PC cards.

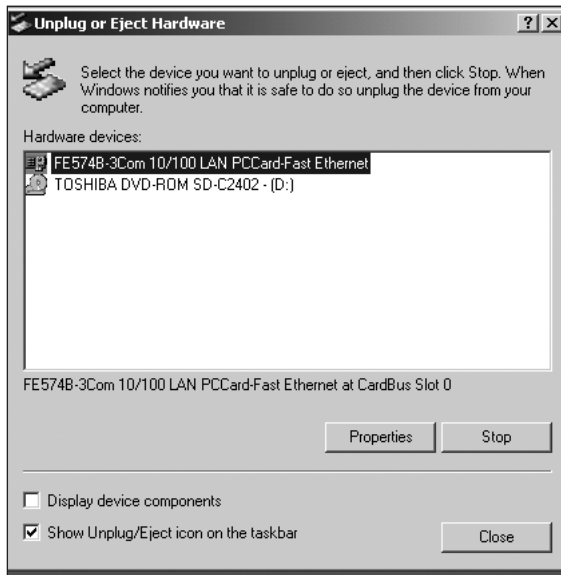


Figure 1-1 Unplug or Eject Hardware dialog box

- **Universal Serial Bus (USB):** Windows 2000 supports the connection of USB devices via an external connector. USB devices can be connected “hot,” while the machine is running.
- **File allocation table (FAT) 32 support:** Windows 2000 offers fully implemented support for the FAT 32 file system. FAT 32 can be used on any partition within the operating system, but many new features such as the encrypting file system require NTFS.
- **Clustering support:** Windows 2000 Advanced Server and Windows 2000 DataCenter Server support for server clusters allows the creation of highly fault-tolerant server configurations. Previously, only the Enterprise version of Windows NT 4.0 made this functionality available.
- **Terminal services:** All versions of Windows 2000 Server include and support terminal services. With this service, you can take previously underpowered client computers and serve applications off of a high-powered applications terminal server. Terminal service also allows highly controlled deployment of specific applications to thin clients such as Windows terminals.

WINDOWS 2000 PRODUCT FAMILY

With the release of Windows 2000, Microsoft continues to provide a fully scalable client/server operating system. Like Windows NT 4.0, Microsoft provides Windows 2000 in four versions to provide specific functions within a network: Windows 2000 Professional, Windows 2000 Server, Windows 2000 Advanced Server, and Windows 2000 DataCenter. This book focuses on the networking services available in the server versions of Windows 2000. It describes the use of Windows 2000 Professional only as a client for these networking services.

Windows 2000 Professional is the client version of the Windows 2000 product family. Its design provides a stable, reliable, 32-bit multitasking operating system for the desktop. In a corporate environment, Windows 2000 Professional gives everyday users a stable platform to run business applications ranging from Microsoft Office to database applications. Support professionals benefit because they can administer Windows 2000 Professional centrally via Active Directory policies. Figure 1-2 shows the minimum and maximum hardware requirements for Windows 2000 Professional.



Minimum requirements:

- Pentium 133
- 32 MB of RAM
- 650 MB of free hard drive space

Maximum hardware:

- Supports 2 processors
- Up to 4 GB of RAM

Figure 1-2 Minimum and maximum hardware specifications: Windows 2000 Professional

Windows 2000 Server is a network operating system designed to provide file, print, application, and Web services to small companies or workgroups within larger corporations. Businesses that currently use Windows NT 4.0 server are likely to upgrade to Windows 2000 Server. Most businesses never need to upgrade to the two more sophisticated versions of Windows 2000 because Windows 2000 Server meets their needs. Figure 1-3 shows the minimum and maximum hardware requirements for Windows 2000 Server.



Minimum requirements:

- Pentium 133
- 128 MB of RAM
- 671 MB of free hard drive space

Maximum hardware:

- Supports 4 processors
- Up to 4 GB of RAM

Figure 1-3 Minimum and maximum hardware specifications: Windows 2000 Server

Windows 2000 Advanced Server replaces the Windows NT 4.0 Enterprise Edition. It is designed to provide file, print, Web, application, and clustering services to large departments or entire enterprise networks. Windows 2000 Advanced Server scales the operating system to support large numbers of processors and huge amounts of RAM. Figure 1-4 shows how well Windows 2000 Advanced Server scales.



Maximum hardware:

- Supports 8 processors
- Up to 8 GB of RAM (if the server supports Intel's Page Address Extension specification)

Figure 1-4 Maximum hardware specifications: Windows 2000 Advanced Server

Windows 2000 DataCenter Server is a new Microsoft offering. No version of Windows NT 4.0 provides the functionality associated with Windows 2000 DataCenter Server. Microsoft designed Windows 2000 DataCenter Server to provide services for massively processor-intensive applications such as large data warehouses or large-scale simulation tasks. Figure 1-5 describes the extent to which DataCenter Server can scale.



Maximum hardware:

- Supports 16 processors out of the box
- Supports 32 processors in special original equipment manufacturer (OEM) versions
- Up to 64 GB of RAM (if the server supports Intel's Page Address Extension specification)

Figure 1-5 Maximum hardware specifications: Windows 2000 DataCenter Server

WINDOWS 2000 NETWORKING ARCHITECTURE

The networking architecture in Windows 2000 borrows heavily from the Windows NT 4.0 model. Overall, the Windows 2000 model is an updated version of the Windows NT 4.0 model, enhanced to provide more services. Like the Windows NT 4.0 model, Windows 2000's networking architecture model is modular, allowing networking components within the model to be changed without requiring a complete rewrite of all networking components. Windows 2000 does this via **boundary layers**, which create standardized interfaces between the different layers of the Windows 2000 networking architecture.

Services found above the **transport device interface (TDI) boundary layer** reside in the upper layers of **OSI model**. Items between the TDI layer and the **network driver interface specification (NDIS) boundary layer** are normally associated with the Network layer of the OSI model. Finally, components below the NDIS layer work at the Data Link or Physical layer of the OSI model. To understand fully the networking architecture of Windows 2000, you must know the functions of the two major boundary layers: TDI and NDIS.

Transport Device Interface

The TDI boundary layer falls between upper-layer services and layer 3 networking protocols. Its main function is to “translate” between the protocols such as TCP/IP and upper-layer services such as redirectors and server services. TDI keeps developers from the unenviable task of rewriting each upper-layer service for each networking protocol. Instead, developers can write to the TDI specification and ensure that upper-layer services work with all current and future networking protocols.

Network Driver Interface Specification

NDIS version 5.0 is the version currently available in Windows 2000. NDIS specifies the boundary layer between network interface card drivers and networking protocols above the NDIS layer. NDIS version 5.0 includes many new features. Two are wake-on-LAN capabilities, the ability to “wake” computers via special network signals; and media sense, the ability to “sense” when a network interface card is actually connected to a network cable. An icon in the information area of the taskbar represents the media sense feature. Figure 1-6 shows the icon (a red X) that signifies that the network interface card is not connected to a “live” network cable.

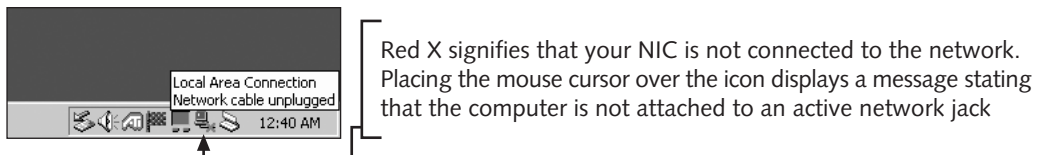


Figure 1-6 Media sense example

Binding is another important function of the NDIS boundary layer. **Binding** is the process of associating or connecting a layer 3 protocol with a specific network interface card. NDIS allows a single protocol to bind to multiple NICs or multiple protocols to bind to a single NIC. Figure 1-7 shows a single protocol bound to multiple NICs.

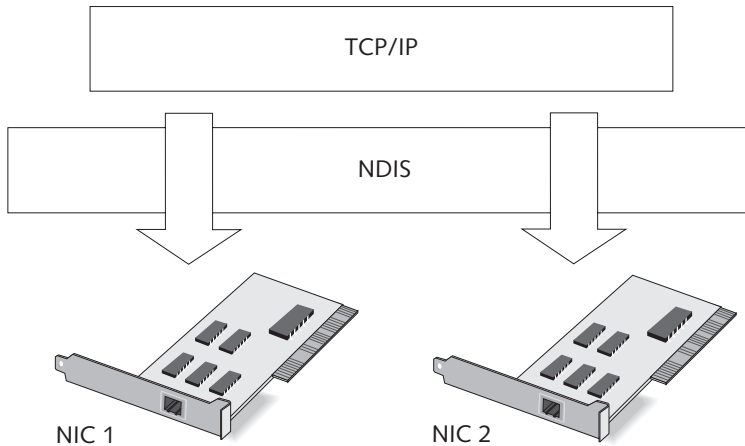


Figure 1-7 Binding single protocol to multiple NICs

Figure 1-7 shows TCP/IP bound to two separate NICs using NDIS services. This process also requires an NDIS-compatible driver for the NIC. All NICs on the hardware compatibility list (HCL) have an NDIS-compatible driver. Figure 1-8 displays multiple protocols bound to a single NIC.

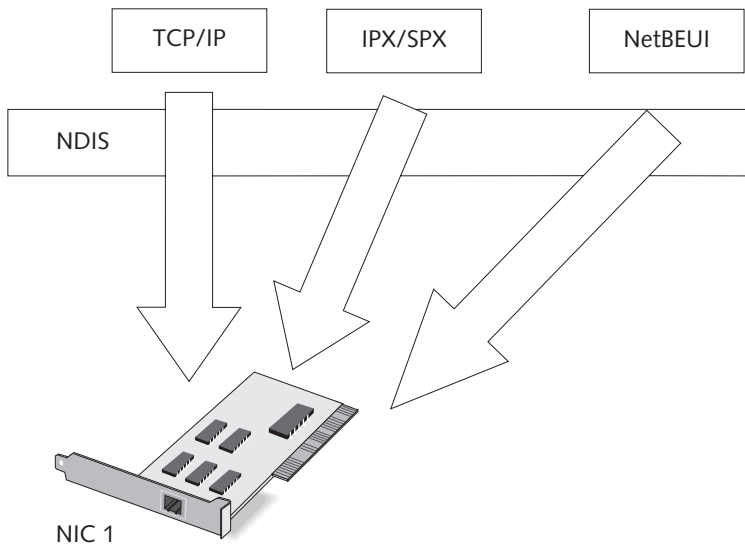


Figure 1-8 Binding multiple protocols to single NIC

The ability to bind multiple protocols to a single NIC is extremely important in any multi-protocol network. These networks, which usually consist of networks running Novell Netware, Unix, and Windows 2000, are very common in today's enterprise networks.

NETWORKING PROTOCOLS OVERVIEW

Windows 2000 supports nearly all the major networking protocols. In addition, the modular nature of Windows 2000 networking architecture allows the easy addition of new and future protocols—**Internet Protocol version 6 (IPv6)**, for instance. Windows 2000 supports the following networking protocols:

- **Transmission Control Protocol/Internet Protocol (TCP/IP):** By default, Windows 2000 includes (and installs) TCP/IP, a routable, layer 3, enterprise-ready protocol stack. TCP/IP, the protocol of the Internet, is the protocol of choice for most networks today. Windows 2000 fully supports a standards-based implementation of TCP/IP. TCP/IP and the services built upon it form the basis for nearly every aspect of this book. Windows 2000 uses TCP/IP for locating servers for domain login and many other functions. Therefore, all Windows 2000 networks must run the TCP/IP protocol stack.



Although Windows 2000 supports many protocols, Microsoft clearly specifies TCP/IP as the protocol of choice. In short, Windows 2000 cannot function without TCP/IP.

- **Internetwork Packet eXchange/Sequenced Packet eXchange (IPX/SPX):** Novell developed this routable, layer 3, protocol stack to provide network connectivity between clients and Novell servers. The Microsoft version of IPX/SPX is NWLink IPX/SPX. Windows 2000 includes this 32-bit version of the protocol stack used by the Novell operating system to allow both operating systems to coexist on a network. NWLink IPX/SPX is discussed in Chapter 2.
- **NetBIOS Enhanced User Interface (NetBEUI):** NetBEUI is a nonroutable protocol originally used to connect computers in small workgroups. Very small, very fast, and very efficient, this protocol's nonroutable nature makes it useless in most modern networks. A nonroutable protocol cannot be routed through layer 3 devices such as routers. In short, you cannot have multiple networks if you use a nonroutable protocol.
- **Data Link Control (DLC):** DLC is a nonroutable protocol originally developed to connect IBM mainframes. Today's networks use DLC to connect to network-enabled printers such as Hewlett-Packard printers with Jet Direct cards.
- **Asynchronous Transfer Mode (ATM):** Windows 2000 now provides native support for ATM via Local Area Network Emulation or LANE.

NETWORKING SERVICES OVERVIEW

Windows 2000 Server includes a wide variety of standard networking services. The operating system can provide everything from dynamic assignment of IP address via **Dynamic Host Configuration Protocol (DHCP)** to dial-up server services via its **Routing and Remote Access Server (RRAS)** components. This book focuses on the installation and administration of these network services, in particular, Dynamic Host Configuration Protocol, Domain Name System, Windows Internet Name Service, Routing and Remote Access, IP Security (described earlier), certificate services and Network Address Translation. The following list briefly describes each of these networking services.

- **Dynamic Host Configuration Protocol:** The DHCP service allows clients to obtain TCP/IP addresses automatically, thus freeing the administrator from manually visiting each workstation. DHCP lets an administrator provide options to clients via option fields. Options can include, but are not limited to, a Domain Name System server TCP/IP address, a Windows Internet Naming Service server address, or a default gateway TCP/IP address.
- **Domain Name System (DNS):** DNS resolves host names to TCP/IP addresses. Its hierarchical nature creates a **Fully Qualified Domain Name (FQDN)** for each host. DNS is critical to the operation of Windows 2000; it is the naming service clients use to find network resources such as domain controllers. **Dynamic DNS (DDNS)**, an extension of the normal DNS service, is available in Windows 2000. DDNS clients can automatically register themselves with the DNS server.
- **Windows Internet Naming Service (WINS):** Mixed mode environments—networks consisting of clients that are aware of the Active Directory and clients that are not—must continue to provide NetBIOS name resolution. WINS resolves NetBIOS names to TCP/IP addresses. This book discusses both NetBIOS names and WINS in detail later in Chapter 5.
- **Routing and Remote Access Server:** Providing a multitude of services to Windows 2000 networks, RRAS handles everything from dial-up connections to portions of TCP/IP routing. Due to its many components, RRAS features prominently in many chapters of this book.
- **Network Address Translation (NAT):** NAT is a new networking service formerly part of the Proxy Server product family. NAT allows companies to use the private address space defined by Request for Comment 1918 to shield their inner network from the outside world. Using two NICs and the private address space, a Windows 2000 machine using NAT can act as a router between the private internal numbers and a public external number.
- **Certificate services:** In Windows 2000, certificate services serve as the bases for a public key infrastructure. Certificate services allow certificates to be issued for digitally signing messages and encrypting e-mail and Web sessions.

CHAPTER SUMMARY

- Windows 2000 takes the modern operating system to new levels of reliability and stability. New features such as Active Directory, plug and play support, Kerberos security, and IP Security help administrators configure and support modern networks. Most of these new features are built into all four versions of the Windows 2000 product family. The client version of the operating system is Windows 2000 Professional. Windows 2000 Server, the workgroup or small business version of the operating system, provides file, print, and Web services. The two other products, Windows 2000 Advanced Server and Windows 2000 DataCenter Server, scale the operating system to the upper end of current hardware and software capabilities.
- The modular Windows 2000 networking architecture enables the operating system to be updated quickly with new protocols or services. Its two main boundary layers, TDI and NDIS, serve as intermediaries within the different components in the architectural model. Also, NDIS allows a single protocol to bind to multiple network interface cards or multiple protocols to bind to a single network interface card.
- Windows 2000 gives a network administrator choice of a wide range of networking protocols. For your network, you can choose to use just TCP/IP (the required protocol for Windows 2000) or you can use any combination of TCP/IP and NWLink IPX/SPX, DLC, NetBEUI, or others.
- Finally, this book focuses on the multitude of networking services available in Windows 2000. The server version of the operating system supports the Domain Name Service, Dynamic Host Configuration Protocol, Windows Internet Name Service, Routing and Remote Access Service, Network Address Translation, and certificate services. These services are the backbone of nearly all modern networks.

KEY TERMS

Active Directory (AD) services — Enterprise-level directory service designed to combine domain structures into a manageable, extensible, network structure.

Asynchronous Transfer Mode (ATM) — Cell-based LAN/WAN networking technology that can handle voice, video, and data traffic; Windows 2000 provides native ATM support.

attributes — Specific values associated with an object; an example is the attribute of First or Last name for the User object.

binding — Associating or connecting a network layer protocol (or even a network service) to a specific network interface card.

boundary layers — Layers in the Windows 2000 networking architecture that act as intermediaries between upper layers, the network protocols, and lower layers of the model.

certificate services — Networking service in Windows 2000 that creates and manages a public key infrastructure within an organization.

- clustering support** — Ability of an operating system to connect multiple servers in a fault-tolerant group. If one server in the cluster fails, all processing continues on another server. Clusters ensure high availability and reliable performance.
- Data Link Control (DLC)** — Nonroutable protocol used mainly to connect to Hewlett-Packard printers using Jet Direct network cards.
- Domain Name System (DNS)** — Network service that provides host name to TCP/IP address resolution.
- Dynamic Domain Name System (DDNS)** — DNS version that allows clients to register their host names automatically with a DNS server.
- Dynamic Host Configuration Protocol (DHCP)** — Networking service that can distribute TCP/IP addresses to clients configured to obtain dynamic addresses.
- encrypting file system (EFS)** — New file and folder attribute provided by NTFS version 5.0; allows file and folder encryption on a per-user basis.
- enhanced security** — Increased security measures available in Windows 2000 via the inclusion of Kerberos version 5 security and IP security.
- Fat allocation table (FAT) 32 support** — Ability of an operating system to read, write, and otherwise fully support the new version of the file allocation table file system introduced in the Win9x product family.
- Fully Qualified Domain Name (FQDN)** — Entire name of a host that includes the host name and the domain name; for example, host1.win2k.org signifies the computer host1 in the win2k.org DNS domain.
- IP Security (IPSec) protocol** — Set of security protocols used to provide data integrity, end-to-end confidentiality, and secure network authentication.
- Internetwork Packet eXchange/Sequenced Packet eXchange (IPX/SPX)** — Routable protocol stack designed by Novell to provide networking services for the Netware network operating system.
- Internet Protocol version 6 (IPv6)** — Advanced version of the Internet Protocol that uses 128-bit addresses in hexadecimal format.
- Kerberos version 5** — Shared secret key encryption mechanism used to provide security for authentication sessions in a Windows 2000 network.
- mixed mode** — Mode that Windows 2000 domain controllers use when the network consists of Windows 2000 servers and Windows NT servers (or machines not Active Directory-aware). All Windows 2000 servers run in mixed mode by default. You must manually change them to native mode.
- native mode** — Mode used by Windows 2000 domain controllers when the entire network consists of only Windows 2000 servers and Active Directory-aware clients.
- NetBIOS Enhanced User Interface (NetBEUI)** — Small, fast, efficient, nonroutable protocol stack used in small networks only.
- Network Address Translation (NAT)** — Network service used to “translate” between public TCP/IP addresses and private internal addresses specified in Request for Comments 1918.

- network driver interface specification (NDIS)** — Boundary layer in the Windows 2000 networking architecture that serves as an intermediary between the networking protocols and the Data Link layer drivers and network interface cards.
- network operating system (NOS)** — Computer software designed to provide network services to clients.
- objects** — Components found within the Active Directory structure; an object represents each network resource in the Active Directory structure
- Open System Interconnection model (OSI model)** — Seven-layer conceptual model designed to help standardize and simplify learning, implementing, and creating network communication between two network hosts.
- plug and play support** — Ability of an operating system to automatically detect and install drivers for devices that conform to plug and play standards; simplifies hardware device management and installation.
- Routing and Remote Access Server (RRAS)** — Windows 2000 networking service responsible for dial-up connectivity and some portions of TCP/IP routing.
- terminal services** — Services that allow a server to host applications for clients; with terminal services, clients no longer used to run applications can act as dumb terminals for applications on a terminal server.
- Transmission Control Protocol/Internet Protocol (TCP/IP)** — Enterprise-ready protocol stack designed to work in heterogeneous networks, that is, networks with many different types of network operating systems.
- transport device interface (TDI)** — Boundary layer in the Windows 2000 networking architecture between networking protocols and the upper-layer services.
- Universal Serial Bus (USB)** — Hardware specification that allows for hot insertion and removal of hardware devices.
- Windows 2000 Professional** — Client version of the Windows 2000 product family; designed to provide a stable, reliable, and fast platform for end users to run their applications.
- Windows 2000 Advanced Server** — Enterprise or large department version of Windows 2000; supports clustering and eight-way multiprocessor systems with up to 8 GB of RAM.
- Windows 2000 DataCenter Server** — Data warehouse or extremely large-scale version of Windows 2000; designed for processor intensive simulations or massive processing tasks; supports up to 32 processors with 64 GB of RAM in special original equipment manufacturer versions.
- Windows 2000 Server** — Small department or workgroup version of Windows 2000; supports four-way multiprocessor systems with up to 4 GB of RAM.
- Windows Internet Naming Service (WINS)** — Network service that provides NetBIOS name to TCP/IP address resolution.

REVIEW QUESTIONS

1. Which one of the following network services provides dynamic assignment of TCP/IP addresses to clients?
 - a. DNS
 - b. DHCP
 - c. RRAS
 - d. NAT
2. Bill needs to replace 100 Windows 98 client machines with a stable, reliable, client operating system. Which one of the following should he install?
 - a. Windows 2000 Server
 - b. Windows 2000 DataCenter Server
 - c. Windows 2000 Advanced Server
 - d. Windows 2000 Professional
3. If you have both Windows 2000 and Window NT 4.0 servers on the same network, for which mode must the Windows 2000 servers be configured?
 - a. Mixed mode
 - b. Fixed mode
 - c. Native mode
 - d. Broadcast mode
4. Which one of the following network services provides NetBIOS name to TCP/IP address resolution?
 - a. DDNS
 - b. WINS
 - c. DHCP
 - d. RRAS
5. What new Windows 2000 feature eases the task of installing and configuring hardware devices?
 - a. Plug and play support
 - b. Kerberos security
 - c. Active Directory services
 - d. Encrypting file system

6. Which one of the following versions of Windows 2000 would provide network services to support a small business with approximately 200 users?
 - a. Windows 2000 Advanced Server
 - b. Windows 2000 Server
 - c. Windows 2000 Professional
 - d. Windows 2000 DataCenter Server
7. What portion of the Windows 2000 networking architecture provides a boundary layer between upper-layer services and network-layer protocols such as TCP/IP?
 - a. TDI
 - b. NDIS
 - c. IDIS
 - d. TNDIS
8. Which of the following networking protocols are routable? (Choose all that apply.)
 - a. TCP/IP
 - b. DLC
 - c. NetBEUI
 - d. NWLink IPX/SPX
9. Network Address Translation provides which one of the following services?
 - a. Dynamic assignment of TCP/IP address
 - b. NetBIOS name to TCP/IP address resolution
 - c. Host name to TCP/IP address resolution
 - d. Translation between private internal TCP/IP addresses and public addresses
10. What process associates a protocol with a particular network interface card?
 - a. NDIS
 - b. Boundary layers
 - c. Binding
 - d. Network associating protocol
11. Which new Windows 2000 Server feature provides enhanced manageability, simplified administration, and increased security through the use of network policies?
 - a. Active Directory
 - b. Kerberos v5
 - c. IP Security
 - d. Plug and play support

12. The _____ allows users to encrypt files and folders on drives formatted with NTFS version 5.0.
13. Which versions of Windows 2000 provide clustering services? (Choose all that apply.)
 - a. Windows 2000 Server
 - b. Windows 2000 Professional
 - c. Windows 2000 Advanced Server
 - d. Windows 2000 DataCenter Server
14. You would like to dual boot Windows 98 and Windows 2000. You should format the first active primary partition with the _____ file system.
15. NDIS allows which of the following? (Choose all that apply.)
 - a. Binding multiple protocols to a single NIC
 - b. Binding certificate services to multiple NICs
 - c. Binding a single protocol to multiple NICs
 - d. None of the above
16. What protocol can you use to connect to HP printers using JetDirect cards?
 - a. NetBEUI
 - b. DLC
 - c. NDIS
 - d. IPX/SPX
17. Which version of Windows 2000 would you use to replace the network operating system on servers in an organization with 100 servers and approximately 25,000 users?
 - a. Windows 2000 Advanced Server
 - b. Windows 2000 Server
 - c. Windows 2000 DataCenter Server
 - d. Windows 2000 Professional
18. Your network consists of only Windows 2000 machines and Active Directory-enabled clients. Which one of the following modes should your domain controllers use?
 - a. Asynchronous mode
 - b. Native mode
 - c. Mixed mode
 - d. Multi mode

19. Which Windows 2000 networking service allows older client machines to be served applications off of powerful server machines?
 - a. Universal Serial Bus
 - b. Clustering support
 - c. Active Directory services
 - d. Terminal services
20. Windows 2000 Server supports up to _____ processors and _____ GB of RAM.

CASE PROJECTS



Case 1

You are hired to design a new network installation for a small engineering firm. The firm, Freytech Inc., currently has Windows NT 4.0 workstations configured in several peer-to-peer workgroups and 75 clients currently in the office. The company owners want to make the best use of existing hardware, but they do understand that they must purchase some new machines. Create a plan to implement a server-based network using Windows 2000 servers. First and foremost, you must justify your decision to choose Windows 2000 by relating the benefits that the operating system's new features would bring to the company. Then you must determine how to configure the servers. Finally, describe what networking protocol or protocols you would configure on the network and what networking services would be appropriate for network use.



Case 2

Your CIO recently read an article concerning the modularization of the Windows 2000 networking architecture. He worries that this limits the operating system's effectiveness for your organization. Create a one-page report detailing why modularization of the Windows 2000 networking architecture actually offers great benefit to your organization.



Case 3

Your network currently consists of Unix workstations, and Windows 3.11, Windows 98, and Windows NT workstations. Also, four Novell Netware servers are running a mission-critical application on the network. As part of a pilot project, you are drafted to provide a PowerPoint presentation detailing how Windows 2000 can be integrated into your network. Create a short presentation detailing the networking protocols supported by Windows 2000 and how they can help Windows 2000 work in your environment.